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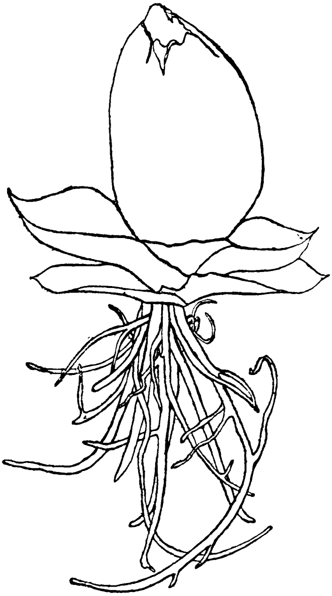
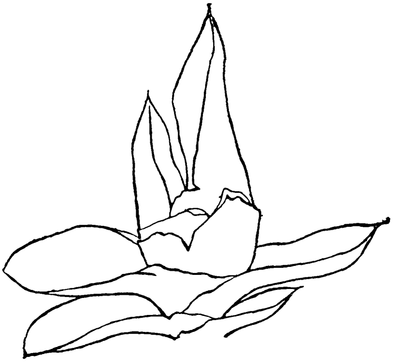
ASCIDIA IN GASTERIA AND AGAVE.

BY J. ARTHUR HARRIS.

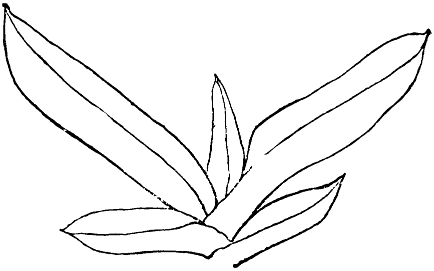
In the summer of 1905 Mr. C. H. Thompson, in charge of the collection of succulents at the Missouri Botanical Garden, called my attention to a peculiarity of two of several young plants of *Gasteria* grown from seed received from the botanical garden at Palermo under the name *G. brachyphylla*.



1. G. BRACHYPHYLLA, × 1.

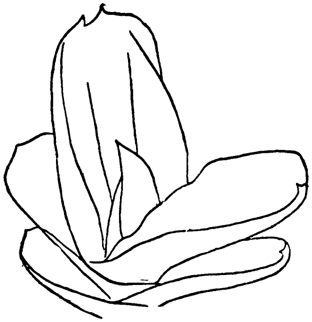


2. G. BRACHYPHYLLA, × 1.

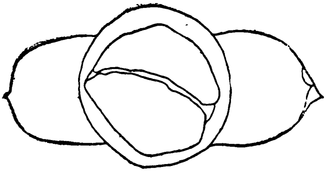


3. G. BRACHYPHYLLA, × 1.

The general appearance of the abnormal plants is shown in figures 1 and 2, while for the sake of comparison a normal specimen from the same lot is shown in figure 3. Figure 1 represents the anomaly at its best. The four earlier leaves are of the normal form, while the remainder of the plant is composed of an ovate organ of the same texture as the leaf, but continuous throughout except for a small, irregular opening at the apex through which a younger leaf is visible. The first impression was that the structure in question consisted of an ascidium formed by the fusion of two leaves as has been described for *Crassula arborescens*,* but Mr. Thompson, upon looking through the rather large series of young plants then growing, found two interesting forms, one of which is represented in figure 4, which were cultivated under the names *G. verrucosa* and *G. trigona*. These seem to show a folding in of one or both margins of the leaf in a way which might indicate that the open calyptra originates from a single leaf developing from a primordium extending entirely around the vegetative point of the axis. In these two cases the tip of the leaf exhibits two apiculae and the same is apparently true for the plant represented in figure 1, though here the irregularity of the opening at the apex precludes a final decision.



4. G. TRIGONA, × 1.



5. G. BRACHYPHYLLLA, × 1.

A transverse section near the base of the ascidium shows it to be composed of a layer of tissue slightly thicker on one side, surrounding two leaves of normal form, but not of the normal distichous arrangement, as may be seen from the diagram, figure 5. This anomaly of the leaf arrangement cannot be regarded as having any special significance since it is frequently to be observed in otherwise normal individuals of *Gasteria.* It seems probable that the ascidium originated from a continuous ring of meristematic tissue.

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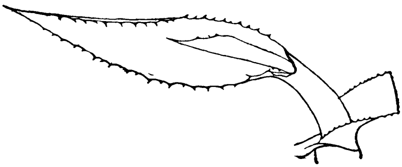
* Morren, C. Bull. Acad. Roy. Sci. Belg. 19^3: 458–462. *pl.* 1852.

The second specimen, figure 2, was seen by the writer only in its present condition, but according to Mr. Thompson it was earlier exactly comparable with the one described above, and reached its present condition by the rupturing of the calyptrà.

A comparable anomaly was seen in one of the leaves of a young plant of *Agave Americana variegata* growing at the Garden. Figure 6 renders any description unnecessary. In the herbarium of the Garden is a photograph of another young plant belonging to a different species of the section Americanae of the same genus, in which precisely the same condition prevails.



6. A. AMERICANA, × ¼.

Foliar ascidia are familiar to biologists in several insectivorous plants. The great interest attaching to these and the curious appearance presented by teratological ascidia have caused the latter to receive particular attention among plant anomalies and more than one monographic treatment has appeared. In 1838 Morren * suggested a classification of all the foliar ascidia known to him. He again published † on this subject in 1852, presenting an elaboration of his classification of teratological forms and citing all cases known to him. In 1863 Kickx ‡ modified and extended the classification proposed by Morren. From this paper the treatment in the work of Masters* is largely taken, though some differences are to be noted. Penzig's† lists are extensive, but his arrangement is purely a systematic one.

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* Morren, C. Bull. Acad. Roy. Sci. Brux. **5**: 430–442, 582–586. 1838.— Ann. Sci. Nat. II. **11**: 119–128. 1839.

† Morren, C. Bull. Acad. Roy. Sci. Belg. **19**^{3}: 444–462. 1852.

‡ Kickx, J. Bull. Acad. Roy. Sci. Belg. II. **16**: 625–632. 1863.

Since Masters's work no general treatment has appeared but several individual cases have been described and some important papers bearing directly or indirectly on the subject have been published. Of these, one by Penzig ‡ and three by De Candolle § should be especially mentioned.

None of the ascidia described in these papers are at all comparable with those here discussed except, perhaps, those of *Tulipa*, *Polygonatum*, *Convallaria*, *Lilium*, *Acanthophippium* and *Vanilla*.

The calyptriform ascidium of *Tulipa Gesneriana* was first mentioned by Hincks ‖ who described it as "a specimen of *Tulipa Gesneriana*, in which the leaf on the stem, folding around it, had cohered by its edges, so as to completely enclose the flower-bud, which, as it enlarged, carried up the upper part of the leaf, like the calyptra of a moss." Saint-Pierre ¶ describes a similar anomaly.

Hincks also mentions a plant of *Convallaria multiflora* "in which the two lowermost leaves cohered by their edges into a sort of a bag, which considerably obstructed the growth of the stem."

Kicks merely mentions a tubiform monophyllous ascidium in *Lilium lancifolium*. He also observed ** a fusiform-cylindrical ascidium of nearly two decimeters in length on the leaf of *Acanthophippium bicolor*. James †† found an ascidium in the leaf of *Masdevallia Lindeni* but no description is given. Jacob de Cordemoy * describes an anomaly in *Vanilla planifolia* which may be exactly comparable with those seen in *Agave* and *Gasteria*. The branches were terminated by an erect, slightly flattened, hollow, fusiform body of eight centimeters in length and one centimeter in thickness. A histological examination showed this organ to be foliar in nature, but the description of the solid stalk of the fusiform body does not permit of a final decision as to the comparability of the tubiform ascidia under consideration.

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* Masters, M. T. Vegetable Teratology. London. 1869.

† Penzig, O. Pflanzen-Teratologie. Genua. 1890–'94.

‡ Penzig, O. Malpighia. **16**: 167–175. *pl. 4–6.* 1902.

§ De Candolle, C. Bull. Soc. Bot. Genève. **8**: 61–69. 1897; **9**: 1–51. 1899. —Bull. Herb. Boissier. II. **2**: 753–762. *pl. 8–9.* 1902.

‖ Hincks, W. Rept. Brit. Ass. Adv. Sci. **7**: 120. 1839.

¶ Saint-Pierre, G. Bull. Soc. Bot. Fr. **1**: 63. 1854.

** Kickx, J. Bull. Acad. Roy. Sci. Belg. **18^1**: 591. 1851.

†† James. Gard. Chron. n. s. **15**: 799. 1881.

The condition in *Polygonatum multiflorum* is of interest in this connection. The first record is that of Morren † of a monophyllous, tubiform ascidium. Later he describes ‡ a specimen in the collection of Hincks as a series of three ascidia through the center of which passed the axis bearing normal leaves and flowers. "Qu'on s'imagine donc un cornet foliacé qui se termine par deux oreillettes latérales et opposées, servant d'étui à deux autres cornets ayant aussi chacun deux oreillettes opposées, et au-dessus d'eux un bouquet de feuilles et de fleurs, et on aura la représentation de cette belle monstruosité, de cette curieuse anomalie." Morren thought it remarkable that the ascidia should have been formed by the fusion of two leaves but this point was, he considered, established by the presence of the two auricles which formed about the terminal fourth of the total length of the ascidia. To give rise to such ascidia the position of the three pairs of leaves must have changed from alternate to nearly opposite.

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* Jacob de Cordemoy, H. Rev. Gén. Bot. **11** : 258–267. *fig. 54–58.* 1899.

† Morren, C. Bull. Acad. Roy. Sci. Brux. **5** : 437, 439, 586. 1838.— Ann. Sci. Nat. II. **11** : 124, 126. 1839.

‡ Morren, C. Bull. Acad. Roy. Belg. **5** : 584–585. 1838; **19**^{3} : 456, 458. 1852.

Puel and Saint-Pierre * also observed an ascidium in this form. The fourth leaf was transformed into a sack with a small opening at the tip through which the stem extended. The fifth leaf was normal while the sixth also had the margins partly fused. The veins of the leaf forming the main ascidium are described as of equal size.

It is now quite impossible to draw any conclusions concerning the ascidia described as diphyllous in *Convallaria* and *Polygonatum*, but the normal arrangement of the leaves in these forms and the condition found in the other Monocotyledons in which ascidia have been found suggests that possibly these anomalies are monophyllous in origin.

Leaves showing a more or less complete longitudinal division into two component parts are among the commonly described foliar anomalies. There are two processes by which such structures might arise: — by the fusion of two adjacent primordia or by the longitudinal division of one already formed. The numerous cases which have been described have been referred, by implication at least, to one of these categories. Pax † and Klein ‡ have suggested criteria for determing the probable method of development of any individual case, but since the necessary data are wanting a correct interpretation of most of the published descriptions is quite impossible. But for our present purpose it is sufficient to note that either the production of two primordia in the region where only one normally occurs or the broadening of the single primordium by division increases the total width of the meristematic region from which a foliar organ is developing. If this region comes to extend entirely around the axis, tubiform ascidia such as those described in this paper may result.

A broadening of the leaf accompanied by longitudinal division for a greater or less distance or the more or less complete fusion of two original primordia has been observed in *Musa Ensete* by Meyran,* in *Tulipa Gesneriana* by Lange,† in *Ophrys aranifera* by Saint-Pierre ‡ in *Orchis maculata* by Clos,§ in *Strelitzia Reginae* by Massalongo,|| in *Richardia aethiopica*, *Colocasia undulata*, *Lolium perenne* and *Potamogeton plantagineus* by Braun¶ and perhaps other cases from the teratolgical literature might be referred to these categories. I have seen the same phenomenon in a specimen of *Agave* sp. growing in the Missouri Botanical Gardens and in the herbarium is a leaf of *A. picta* showing the same anomaly. While such divided leaves may not be described as intermediate between the normally developed leaf and the tubiform ascidia — which have as yet been observed only in the Monocotyledons — it seems possible that there is some similarity in their mode of development.

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* Puel and Saint-Pierre. Bull. Soc. Bot. Fr. **1**: 62–63. 1854.

† Pax, F. Allg. Morph. Pfl. 92. 1890.

‡ Klein, J. Jahrb. Wiss. Bot. **24**: 425–498. *pl. 13–18*. 1892.

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* Meyran, O. Bull. Soc. Bot. Lyon. II. **3** : 123–124. 1885.

† Lange. Bot. Tids. **7** : 209. 1873–74.

‡ Saint-Pierre, G. Bull. Soc. Bot. Fr. **23** : xxxvi–xl. 1876.

§ Clos, D. Bull. Soc. Bot. Fr. **36** : ccx. 1889.

|| Massalongo, C. Nuovo Giorn. Bot. Ital. **20** : 283. *pl. 16.* 1888.

¶ Braun, A. Sitzb. Ges. Naturf. Freunde, Berlin. **1871** : 7.